TWO NEW SPECIES OF *GUADUA* (BAMBUSOIDEAE: GUADUINAE) FROM COLOMBIA AND BOLIVIA

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ABSTRACT

Guadua incana and **G. chaparensis,** two new species of woody bamboo from South America, are described and illustrated. **Guadua incana,** from southeastern Colombia, has been found in the foothills of the eastern side of the Cordillera de los Andes, and **G. chaparensis,** from Bolivia, occurs in the Amazon lowlands in the District of Chapare. Based on morphological evidence, **G. incana** and **G. chaparensis** are closely related to **Guadua weberbaueri,** which is lectotypified here. We discuss other related species and provide a key to them.

RESUMEN

Se describen e ilustran dos especies nuevas para Sur América, **Guadua incana** y **G. chaparensis. Guadua incana** del suroriente de Colombia, crece en el pie de monte de la vertiente oriental de la Cordillera de los Andes, y **G. chaparensis** de Bolivia, se localiza en el Distrito Biogeográfico Amazónico del Chapare. Con base en evidencias morfológicas, **G. incana** y **G. chaparensis** se relacionan entre si y también con **Guadua weberbaueri,** la cual se lectotipifica aquí. Además, se hacen comentarios sobre otras especies afines y se incluye clave para identificación.

During a 1987 field trip to Caquetá and Putumayo, Colombia (Colciencias-Inciva Project No. 2108-07-009-85), sterile specimens of a new species of *Guadua* (*Londoño & Quintero 144 & 214*) were collected. A living rhizome was brought to the bamboo germplasm bank of the Juan Maria Cespedes Botanical Garden in Tuluá, Valle del Cauca, Colombia, and after 14 years in cultivation (1987–2001), accessions *Londoño 144 & 214* flowered and made possible their identification.

Because of the absence of flowering material in the majority of woody bamboo herbarium specimens (in part, a result of their long flowering cycles), several species of bamboo are described from vegetative material alone, e.g., *Eremocaulon setosum* Londoño & L.G. Clark, *Chusquea riosaltensis* L.G. Clark and *Ch. caparaoensis* L.G. Clark (Londoño & Clark 2002a; Clark 1992). Vegetative characters such as culm leaves, buds, branches and rhizomes have been utilized to delimit many new species (McClure 1966; Judziewicz et al. 1999; Soderstrom & Young 1983). We waited 14 years for the opportunity to describe *G. incana* with flowering material, but for the new species from Bolivia, *G. chaparensis* Londoño & Zurita, we decided to describe it on the basis of sterile material alone, in order to provide a name for this distinctive species.

In addition to the vegetative and reproductive characters used to delimit *G. incana*, the genetic AFLP analysis done by Marulanda et al. (2002) reported a clear genetic differentiation between *G. incana* and *G. angustifolia* (accessions, varieties and biotypes), and also between *G. incana* and *Guadua uncinata* Londoño & L.G. Clark (2002b), a species that is sympatric with *G. incana*. This genetic result helped corroborate the diagnostic morphological features that identify *Guadua incana* as a new species.

Guadua chaparensis was collected by the second author in central Bolivia. It occurs not only in the type locality (Comunidad Israel) but in various communities such as Capinota, Hermanos Ledesma, Agua Rica, 24 de Septiembre, Monte Sinaí, Villa Jerusalen, Villa Imperial, Valle de Sajta, Valle Ivirza, Villa Nueva, Alto San Pablo, Tarija and Puerto Aroma, all of them in the Chapare area.

The two new species, *G. incana* and *G. chaparensis*, are clearly referable to *Guadua* based on their long-necked rhizomes, white bands on the culms, thorny branches, triangular culm leaves, and, in the case of *G. incana*, pseudospikelet structure with winged-keeled palea (Judziewicz et al. 1999). Both species are closely related,

grow in lowland tropical rain forests, and appear to be endemic to the localities in which they were collected. Both are also utilized by local communities for corrals, fences, water conduction and light rural construction.

Guadua weberbaueri, the taxon most closely allied to the two new species, was described by Pilger (1905), who selected as the holotype number 4562 collected by the German botanist August Weberbauer (1871–1948) in Moyobamba, Perú. As with many other collections by Weberbauer, the type chosen by Pilger and deposited in Berlin (B) was destroyed during World War II. In 1991, the first author visited the herbarium of the Universidad Nacional Agraria, La Molina (MOL) in Lima, Peru, and found a complete duplicate of *Weberbauer 4562*. This isotype, which we have selected to serve as the lectotype, includes a foliage leaf complement and one inflorescence branch.

Morphological study reveals that *Guadua weberbaueri* Pilger, *G. tagoara* (Nees) Kunth and *G. sarcocarpa* Londoño & Peterson (1991) share several features with each other and the two undescribed species, forming the basis for a group within *Guadua*, here recognized informally as the *G. weberbaueri* Group (Table1). The following combination of characters delimits this group: a) culms erect at the base with the apical portion leaning on or pendent from trees; b) internodes hollow, with walls up to 1.5 cm thick, elongated up to 90 cm; c) culm leaves with persistent blades, these 1/4 to 1/5 as long as the sheaths; d) culm leaves with canescent inner ligules; e) synflorescences terminating in leafy or leafless branches with capitate coflorescences in the earliest state of development; f) pseudospikelets with wide-winged palea keels (0.8 to 2.5 mm); and g) ovaries fusoid in shape.

These five species, *Guadua weberbaueri*, *G. sarcocarpa*, *G. incana*, *G. chaparensis* and *G. tagoara*, grow in very humid, lowland forests and they have in common the presence of water inside of the hollow internodes. Herbarium labels from *Guadua sarcocarpa* (*Calderon & Soderstrom 2348*-US#2810196 and *Smith 5275*-US#3080541), the description for *G. tagoara* in Londoño and Clark (2002b), and Louton et al. (1996) for *G. weberbaueri* reported the presence of internodes filled with water. This internal water phenomenon seems to be associated with very high relative humidity and a high water table. Why water accumulates inside the internodes is still uncertain. It may occur after strong changes of temperature that break tissues allowing water to leak into and accumulate in the lumen.

A key to the species of the *G. weberbaueri* group based on vegetative characters is presented here.

KEY TO SPECIES OF THE *GUADUA WEBERBAUERI* GROUP

1. Culm leaves abaxially puberulous to pubescent, the indument detached only with difficulty from the surfaces, the margins slightly discontinuous at the junction of the sheath and blade.
   2. Foliage leaf sheaths abaxially pubescent, bearing fimbriae at the summit; folage leaf blades abaxially pilose and inconspicuously tessellate; inner ligules pubescent; pseudopetioles abaxially setose-pilose; culm leaf auricles absent _____ **G. weberbaueri**
   2. Foliage leaf sheaths abaxially glabrous with oral setae and fimbriae at the summit; foliage leaf blades abaxially irregularly glabrescent and conspicuously tessellate; inner ligules glabrous; pseudopetioles abaxially glabrous; culm leaf auricles absent or present _____ **G. sarcocarpa**
1. Culm leaves abaxially densely pubescent to canescent, the indument easily detached from the surfaces, the margins continuous or slightly discontinuous at the junction of the sheath and blade.
   3. Culms erect below with spreading branches above, and leaning on or pendent from trees; foliage leaf blades glabrous on bot surfaces and abaxially strongly tessellate; pseudopetiole abaxially glabrous; Brazil _____ **G. tagoara**
   3. Culms erect below, arching apically, lacking spreading branches above and not leaning on or pendent from trees.
      4. Foliage leaf sheaths glabrous, fimbriae at the summit, fimbriae 4–5 mm long; inner ligules glabrous; leaf blades abaxially subglabrous; pseudopetioles abaxially glabrous; Colombia _____ **G. incana**
      4. Foliage leaf sheaths subglabrous, not fimbriate at summit; inner ligules puberulous; leaf blades abaxially glabrous; pseudopetioles abaxially glabrescent; Bolivia _____ **G. chaparensis**

Guadua incana Londoño, sp. nov. (**Fig. 1**). TYPE: COLOMBIA. CAQUETÁ: Km 26.7 via Florencia-Guadalupe, Quebrada La Rebolcosa, vertiente oriental de la Cordillera Oriental, 750 m, cultivated at the Botanical Garden Juan María Céspedes, 2 Jun 2001 (fl), *X. Londoño 972* (HOLOTYPE: COL!, ISOTYPES: CUVC, TULV, ISC, US).

Bambusa lignosa, spinosa. Rhizoma sympodiale, pachymorphum. Culmi 10–15(–18) m alti, 7–9(–12) cm diam.; internodia (20–)30–65 cm longa, cava. Folia culmorum leviter coriacea, canescentia, deciduas, vagina et lamina conspicue distinctae in ju-

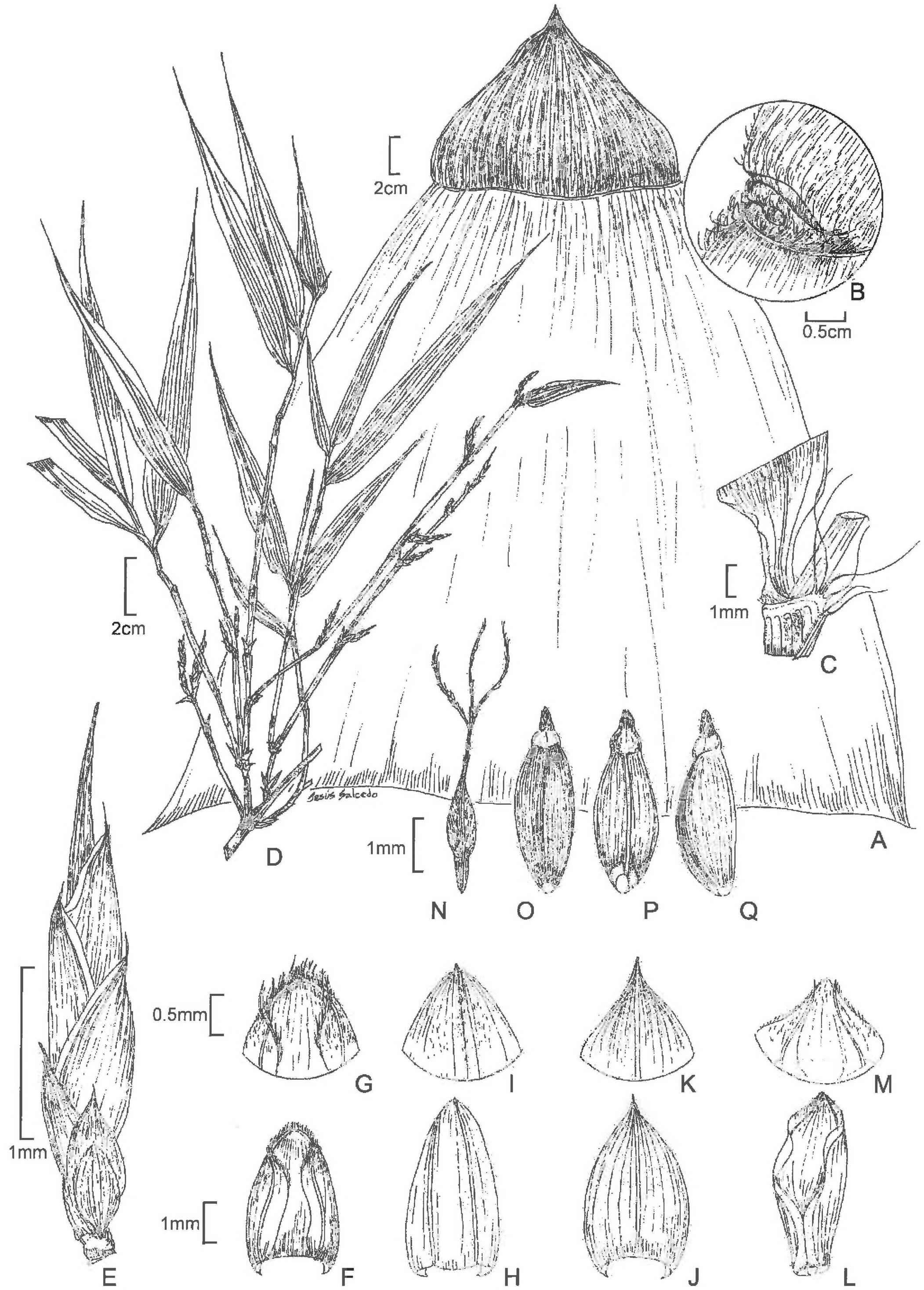

Fig. 1. *Guadua incana*. **A.** Culm leaf, adaxial view. **B.** Detail of culm leaf showing blade base and sheath summit, adaxial surface. **C.** Foliage leaf ligular area, abaxial view. **D.** Mid-culm node with branch complement of leafy flowering axis. **E.** Pseudospikelet showing basal gemmiparous bracts, a sterile lemma, fertile florets, and terminal rudimentary florets. **F–G.** Prophyll, abaxial view and apex. **H–I.** Basal gemmiparous bracts, abaxial view and apex. **J–K.** Lemma, abaxial view and apex. **L–M.** Palea, abaxial view and apex. **N.** Gynoecium with three stigmas. **O–Q.** Caryopsis with a stylar column; dorsal view showing the hilum (O), frontal view showing the embrotegium (P), and lateral view (Q). (A–C, *Londoño 144*, TULV; D–Q, *Londoño 972* TULV).

ventute; vagina (19–)24–33 cm longa; lamina (3.5–)5–10 cm longa, persistens, erecta, triangularis. Ramificatio intravaginalis. Folia ramorum cujusquisque complementi 5–8(–10); vagina subglabra, fimbriata, margine imbricata, conspicue ciliata; pseudopetiolus 2–4 mm longus; lamina (3.5–)11–13(–16) cm longa, (0.7–)1–2(–2.2) cm lata, lineari-lanceolata. Synflorescentia 1–4(–6) coflorescentiis, 1–5 multifloris pseudospiculis munitis. Pseudospiculae 2–4 cm longae, 0.4–0.7 mm lata; lemma 9–11.5 mm longum, 6–8 mm latum; palea 9–11 mm longa, 4–5 mm lata. Ovarium fusiforme, (1.5–)2–3 mm longum, 0.4–0.5 mm latum.

Woody, thorny bamboo. Rhizomes pachymorph. **Culms** 10–15(–18) m tall, 7–9(–12) cm in diam., erect at base, arching apically, whitish-green when young; **internodes** (20–)30–55(–65) cm long, cylindrical, hollow, some filled with water, the wall 1–1.5 cm thick, the surface whitish-green pubescent when young, becoming evidently whiter below the nodal line, covered by very appressed, white, soft, slender, retrorse hairs; **nodes** solitary, the nodal line horizontal, with a supranodal band 1–1.7 cm wide of appressed, white, soft, slender hairs, and an infranodal band 1.5–2 cm wide of long, soft, slender, white, appressed hairs, the two bands unambiguously evident, the supranodal ridge slightly pronounced, the canescence from the infranodal band extending 2/3 along the internode; **bud** single, triangular, the shoulders of the prophyll ciliate. **Culm leaves** (22–)30–44 cm long, 29–44 cm wide at the base, coriaceous, deciduous, triangular, blade and sheath conspicuously distinguished by color and pubescence when young; **sheaths** (19–)24–33 × 29–44 cm, whitish-green with yellowish spots when young, becoming whitish-brown to stramineous, abaxially canescent-hispid, densely covered by two different types of hairs (1) short, matted, white and wavy hairs, looking like wool and easily detached, and (2) straight, stiff, sharp, amber hairs, up to 3 mm long, adaxially glabrous and shiny, the margins papery, the overlapping one ciliate, the cilia transparent, up to 2.5 mm long; **inner ligules** 0.5–1.0 mm long, truncate, straight to slightly curled in the middle, extending completely from margin to margin, adaxially glabrous, abaxially canescent, densely ciliate on the margin, the cilia up to 0.6 mm long, whitish in color and conspicuous; **blades** (3.5–)5–10 × 7–12 cm, 1/4–1/5 as long as the sheath, triangular, erect, persistent, inflated, green to reddish-green when young then brown, abaxially glabrous at the central inflated part, sparsely hispid and pubescent through the apex and marginally, adaxially densely pubescent between the nerves, covered by two types of hairs (1) firm, stiff, transparent hairs up to 2.5 mm long, and (2) short, soft, loose hairs up to 0.5 mm long, the margins papery, shiny and smooth at the middle and upper portion, basally ciliate, wrinkled at the junction with the sheath and bearing conspicuous fimbriae and cilia, the cilia up to 2.5 mm long, hyaline, rubbing off at the middle and upper portion, the fimbriae 3–5 mm long, ivory, wavy to curled, basally scabrid, apically smooth, the apex strongly mucronate and usually split in two parts, the mucro up to 1 mm long. **Branching** intravaginal, consisting of one main branch and 1 to 2 secondary branches, the branches manifestly armed, thorns 1 to 3(–4) per node, the central one dominant, bigger and straight to slightly curved, the other two slightly curved to curved. **Foliage leaves** 5 to 8(–10) per complement; **sheaths** abaxially pubescent to glabrous, usually with a patch of villous hairs on one side of the midnerve at the upper portion, green when young then stramineous, the overlapping margin conspicuously ciliate, the underlapping one minutely cililate to smooth and papery, bearing a few fimbriae at the summit; fimbriae 4–5 mm long, ivory, basally straight and scabrid, apically wavy to curled and smooth; **inner ligules** 0.2–0.3 mm long, short, brown, puberulous, ciliolate to smooth at the margin; **outer ligules** 0.3–0.4 mm long, stramineous, glabrous, shiny, the margin ciliolate to smooth; **pseudopetioles** 2–4 mm long, adaxially scabrous toward one margin, otherwise glabrous, abaxially glabrous, pulvinate, the pulvinous villous, stramineous to brown; **blades** (3.5–)11–13(–16) × (0.7–)1–2(–2.2) cm, L:W = 5–14:1, 13–15 nerved, linear-lanceolate, adaxially glabrous to subglabrous, with scattered, strigose, transparent hairs up to 1.2 mm long, with 4–6 raised scabrid submarginal nerves on one side, becoming basally evidently scabrous by one side, abaxially glabrous to subglabrous, with scattered strigose, transparent hairs up to 1 mm long, papillose and tessellate, the midnerve and primary nerves prominent and yellow in the middle and lower portion, one margin scabrid, the other scabridulous, the apex acuminate, with a mucro 2–3 mm long. **Synflorescences** terminating usually leafy branches of all orders, polytelic, consisting of 1–4(–6) coflorescences with 1–3(–5) multiflowered pseudospikelets; **main axes** basally glabrous, apically pilose; **subtending bracts** varying in size and shape through the main axis, from fully developed and similar to a small foliage leaf to triangular with a reduced apiculus, the blades

TABLE 1. Comparison of vegetative morphological characters of *Guadua incana, G. chaparensis, G. tagoara, G. weberbaueri,* and *G. sarcocarpa.*

CHARACTER	*incana*	*chaparensis*	*tagoara*	*weberbaueri*	*sarcocarpa*
Culm habit	erect basally, arching apically	erect basally, arching apically	erect basally, branching and reaching over trees	erect basally, arching apically	erect basally, branching and reaching over trees
Culm size					
length (m)	10–15(–18)	18–25	10–15(–20)	8–15(–20)	10–20(–30)
diameter (cm)	7–9(–12)	(3.5-)7–12	5–10	4–8(–12)	8–10
Internode size					
length (cm)	20–65	22–70	25–80	25–70	25–90
wall thickness (cm)	1–1.5	1–1.5	0.5–1	1–1.5	1
Culm leaf auricles	absent	absent	absent	absent	absent/present
Culm leaf inner ligule					
size (mm)	0.5–1	0.5–1	1–2	1–3	2–3
abaxial indument	canescent	canescent	canescent	canescent	canescent
Foliage leaf sheath					
indument	subglabrous, with a patch of hairs at the apex	subglabrous with a patch of hairs at the apex	subglabrous with a patch of hairs at the apex	subglabrous	glabrous
margin	conspicuously ciliate	conspicuously ciliate	ciliate	ciliate	smooth and papery
summit	fimbriate	glabrous	fimbriate, rarely with auricles	fimbriate	oral setae or fimbriae
Pseudopetiole					
length (mm)	2–4	2–4	4–10(–15)	5–7	(4–)6–10
abaxial indument	glabrous	glabrous	glabrous	setose-pilose	glabrous
Foliage leaf blade, abaxial indument	glabrous to subglabrous	glabrous	glabrous	pilose to glabrous	irregularly subglabrous
Pseudospikelet size (cm)	2–4 x 0.4–0.7	not seen	0.5–4 x 0.2–0.6	0.5–2.5 x 0.2–0.7	1.2–8.5 x (0.2–) 0.5–1.2
Lemma, abaxial surface	subglabrous	not seen	usually glabrous	pubescent	glabrous
Palea					
sulcus	strigillose	not seen	puberulent	pubescent	pubescent
wing width (mm)	1–1.2	not seen	0.8–1.2	0.8–1	(1–)1.8–2.5
Fruit type	dry caryopsis	not seen	dry caryopsis	dry caryopsis	fleshy caryopsis
Geographical distribution	Colombia	Bolivia	Brazil	Peru	Peru, Bolivia, Brazil, Colombia Ecuador, Guyana, Surinam & Venezuela

when present deciduous, the sheaths adaxially pubescent and bearing fimbriae at the summit, the overlapping margin conspicuously ciliate. **Pseudospikelets** 2–4 × 0.4–0.7 cm, linear-lanceolate, straight to slightly curved, green when young becoming stramineous, consisting of a subtending bract, a prophyll, 1–4(–5) gemmiparous bracts, 1–2 sterile lemmas, 5–7 functional florets, terminating in a rudimentary anthecium; **prophylls** 4 × 2 mm, with the 2 keels winged, the sulcus membranaceous, abaxially glabrous except sericeous at the tip and strigillose along the keels, the enfolding margins glabrous and shiny, except strigillose along the keels, with the margins ciliolate, the wings 0.2–0.3 mm wide, pubescent on both sides, conspicuously ciliate on the margin, the cilia up to 0.5 mm long; **gemmiparous bracts** 1–4(–5), 5–9 × 3–6 mm, 7–11-nerved,

ovate to ovate-lanceolate, deciduous, adaxially shortly pubescent toward the upper third, otherwise glabrous and shiny, abaxially sparsely pubescent, with the midnerve strongly marked, the apex mucronate, the mucro 0.5–0.7 mm long, the overlapping margin conspicuously ciliate, the underlapping one minutely ciliolate except basally; **sterile lemmas** 1–2, 6.5–8 × 5–6 mm, 10–16-nerved, ovate-lanceolate, stramineous, slightly lighter in color than the lemmas, mucronate, the mucro 0.5 mm long, abaxially glabrescent, adaxially pubescent on the upper ½, being densely pubescent toward the apex, the overlapping margin minutely ciliolate, the underlapping one smooth, enclosing a rudimentary palea or not; **rachilla segments** 3–4.5 mm long, shortly pubescent except at the most lower portion, with a rim of hairs at the uppermost portion, disarticulating below the attachment of each lemma and falling attached to the floret. **Fertile florets** 5–7, 10–11 × 2–4 mm, with the winged palea keels exceeding the lemma margins, the lemma exceeding the palea apically only by the mucro; **lemmas** 9–11.5 × 6–8 mm, 16–18-nerved, ovate-lanceolate, green when young with purplish margins, becoming stramineous, abaxially glabrous, except with a patch of very short hairs dorsally, and a purplish-tinged to darker color line along the margins, adaxially pubescent on the upper half otherwise glabrous, the apex mucronate, the mucro 0.5–1 mm long, the margins smooth, papery; **paleas** 9–11 × 4–5 mm, stramineous, the apex acute, the sulcus 2 mm wide, 3–4-nerved, strigillose, covered by transparent, short, appressed hairs, the enfolding margins 2–3-nerved, glabrous, the margins smooth, the keels winged, the wings 1–1.2 mm wide, wider apically than basally, 2-nerved, purplish to stramineous, abaxially glabrous and shiny, adaxially strigillose along the sulcus and apically, otherwise glabrous and shiny, not prolonged at the apex, the margins ciliolate on the upper half, basally sparsely ciliolate. **Lodicules** 3, 2.5–5 × 0.7–1.8 mm, 8–12-nerved basally, membranous, acute, the upper half puberulous and thinner, covered by hyaline prickles, basally glabrous, thickened, nerved and darker, the margins sparsely ciliolate at the tip, the anterior pair slightly asymmetrical, the posterior one symmetrical, narrower than the anterior pair. **Stamens** 6, the anthers 4–5.2 × 0.1–0.5 mm, brown, basally sagittate, apically apiculate, the filament free, up to 2 mm long. **Ovary** (1.5–)2–3 × 0.4–0.5 mm, fusoid, the basal half receptacle-like, 0.7–1 × 0.5 mm, glabrous, brown, the upper half cone-shaped, 1–2 × 1 mm, densely antrorse-hispidulous, stramineous; **style** 2–2.5 mm long, densely antrorse-hispidulous, darker than the ovary, stigmas 3, plumose, ca. 5 mm long. **Fruit** 7–9 × 3 mm, an asymmetric fusoid caryopsis, with a persistent hispidulous style base at the apex, shiny and glabrescent immediately below the style, the basal two-thirds minutely strigillose, opaque, glaucous; **embryo** 1.5 × 1 mm, circular, lateral at the base of the caryopsis.

Etymology.—The specific epithet refers to the evidently canescent abaxial surfaces of the culm leaf sheath when young.

Distribution and habitat.—This species occurs in southern Colombia, in the departments of Caqueta and Putumayo, in the foothills of the eastern side of the Cordillera Oriental de los Andes, at elevations between 280–1200 m. It grows in the interior of very humid mountain forests, along creėks, but does not form dominant clumps and is generally uncommon.

Common name.—*Guadúa* (with accent).

Uses.—Farm fences and light rural infrastructure.

Phenology and Fruiting.—The flowering behavior of bamboos is still unexplained and mysterious. The factors that switch a bamboo plant from a vegetative to a flowering state are not fully understood (Janzen 1976; Judziewicz et al. 1999). *Guadua incana* can flower continuously for at least 2–3 years and without dying. A flowering culm in this species is leafy and the production of fruit and seedlings is uncommon. As in *G. weberbaueri*, only a few culms from the whole clump flower at any given time. Despite this research, it is still impossible to establish its regular flowering cycle, but we know that it takes at least more than 14 years.

The production of mature fruit in *G. incana* is scarce. Only one fruit was found in a functional floret from the middle part of the pseudospikelet. This floret falls along with the rachilla, lemma and palea attached to the base as in other *Guadua* species, e.g., *G. chacoensis* (Rojas) Londoño & Peterson (Londoño & Peterson 1992). The dorsal surface of the fruit has a conspicuous linear hilum, purplish in color, extending down the

length of the fruit and the ventral surface has a prominent embryotegium. The embryo is 1/5–1/6 of the length of the whole fruit, and is located at the base of the ventral surface. The indument of the fruit is very peculiar, with the upper 1/9th nitid; otherwise, the fruit is strigillose and covered with a whitish waxy coating.

Pseudospikelet.—The pseudospikelet is a synapomorphy for *Guadua* + *Eremocaulon* within the subtribe Guaduinae (Ruiz et al., in press), and among Neotropical woody bamboos is also found only in the genera *Elytrostachys* McClure, *Alvimia* Soderstrom & Londoño, and *Atractantha* McClure, all of them in the subtribe Arthrostylidiinae. The term is used to describe synflorescences of woody bamboos that rebranch to produce successive orders of spikelets (McClure 1966; Judziewicz et al. 1999; Young & Judd 1992, Bamboo Phylogeny Working Group 2005). According to Londoño and Clark (2002b) the following structures are all homologous at some level: subtending bracts, gemmiparous bracts, glumes, and both sterile and fertile lemmas. However, this is not the case with the prophyll, which is homologous to the palea (Stapleton 1997; Bamboo Phylogeny Working Group 2005). In *G. incana*, the most proximal bract to the prophyll gives the impression of being the prophyll itself, because the midnerve is similarly keeled and conspicuously asymmetrical, the apex bifurcate and shortly mucronate, and always fertile, enclosing a bud (Fig. 1: H–I). The prophyll when present is conspicuously ciliate but frequently the hairs rub off *in situ*.

Affinities.—*Guadua incana* is most similar to *G. weberbaueri* Pilger and *G. sarcocarpa* Londoño & Peterson. The three species share the following characters: a) triangular culm leaves with the margins slightly discontinuous at the junction with the blade; b) culm leaf blades 1/4 to 1/5 as long as the sheaths, adaxially pubescent and with a strong mucro at the apex; c) adaxial surfaces of the lemmas pubescent on their upper halves; d) paleas with pubescent sulcuses; e) conspicuous winged keels more than 0.8 mm wide and ending in an acute apex; f) lodicules strigilllose in the upper third; and g) ovaries and styles antrorse-hispidulous.

However, *G. incana* differs from *G. weberbaueri* and *G. sarcocarpa* in having (1) blade and sheath of the culm leaves conspicuously distinguished by color and pubescence (vs. inconspicuously distinguished by color and pubescence); (2) subglabrous adaxial surfaces of the leaf blades (vs. entirely glabrous); and (3) strigillose sulcus of the palea (vs. pubescent) (Table 1).

Guadua incana differs from *G. sarcocarpa* in its (a) culms erect at base, arching apically (vs. erect at base, then branching above and reaching over trees for support); (b) white-greenish and hairy culm leaves when young, (c) conspicuously ciliate overlapping margin of the foliage leaf sheaths, (d) shorter and narrower pseudospikelets, (e) the winged palea keels marginally ciliolate, and (f) dry caryopsis fruit. It differs from *G. weberbaueri* in its (a) longer pseudospikelets, (b) smooth and papery margins of the lemma, (c) abaxially glabrous but basally sparsely ciliolate winged palea keels (Table 1).

Guadua incana and *Guadua tagoara* share (a) ciliate foliage leaf sheath margins, (b) similar pseudospikelet size, (c) gemmiparous bracts with the midnerve strongly marked, (d) the lemma margins exceeded by the winged-keels of the palea, (e) a palea with two conspicuous winged-keels and a pubescent sulcus between nerves; and (f) a fusoid antrorse-hispidulous ovary (Table 1).

According to the molecular analysis done by Marulanda et al. (2002), *G. incana* shows a wide genetic distance in relation to *G. angustifolia* and greater genetic similarity with *G. amplexifolia* which shares a canescent indument on the abaxial surfaces of the culm leaf sheaths, the inner ligule extending from margin to margin and the strong mucro at the apex of the culm leaves; DNA isolation for *G. weberbaueri*, *G. sarcocarpa* and *G. tagora*, the three closely allied species, was not successful in the above mentioned research.

Additional specimens examined. **COLOMBIA. Caquetá:** Km 26.7 vía Florencia–Guadalupe, Quebrada La Rebolcosa, vertiente oriental de la Cordillera Oriental, 750 m, 10 Feb 1987, *Londoño & Quintero 144*; cultivated, Jardín Botánico Juan Maria Céspedes, Plot #3 collection No. XL114, 2 Jun 2004 (fl), *Londoño 982* (COL,TULV, US); Km 22 vía Florencia–Guadalupe, 670 m, 9 Feb 1987, *Londoño & Quintero 122* (TULV). **Putumayo:** Mpio. Mocoa, Vereda Suiza, carretera Mocoa-Pasto, después de La Tebaida, a orilla de Q. Suiza, 1050 m, 6 Mar 1987, *Londoño & Quintero 214* (COL, TULV, US); cultivated Jardín Botánico Juan Maria Céspedes, Plot #3 collection No. XL214, 2 Jun 2001 (fl), *Londoño 973* (TULV, US).

Guadua chaparensis Londoño & Zurita, sp. nov. (**Fig. 2**). TYPE: BOLIVIA. COCHABAMBA: Prov. Carrasco, Distrito Chapare, localidad Israel, orilla del Río Sajta, 270 m, 17° 12' 33" S, 64° 49' 47" W, 8 Aug 2004, *E. Zurita & J. Huaranca EZ 302* (HOLOTYPE: BOLV; ISOTYPES: BOL, COL, TULV, US).

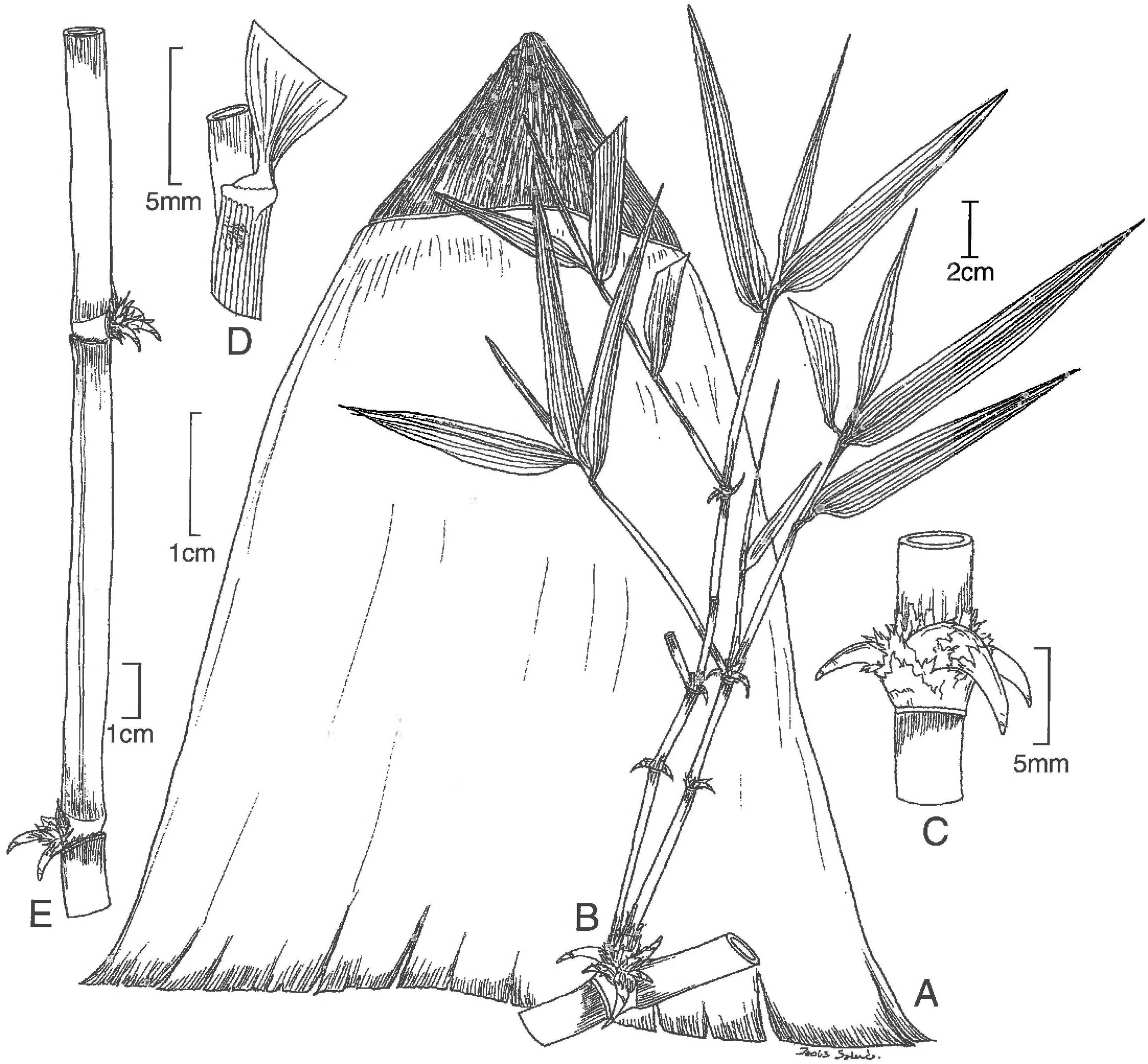

Fig. 2. *Guadua chaparensis*. A. Culm leaf, adaxial view. B. Mid-culm node with branch compliment showing secondary branches and recurved thorns. C. Thorny branch. D. Foliage leaf ligular area, abaxial view. E. Culm segment, with thorns at the nodes (*Zurita 302*, BOLV).

Bambusa lignosa, spinosa. Rhizomata pachymorpha. Culmi 18–25 m longi (3.5–)7–12 cm in diam.; internodia 22–70 cm longa. Folia culmorum 29–57 cm longa, 35–54 cm lata ad basim, coriacea, decidua, triangularia, vagina et lamina conspicue distinctae in juventute (vagina albido-brunnea et lanuginosa versus lamina viridis et glabrescens); vagina 23–50 cm longa; lamina (4–)9–15 cm longa, 14–17 cm lata, triangularis, erecta, viridis ad viridi-rubescentem, inflata in juventute. Folia ramorum cujusquisque complementi 5–8(–10); vagina abaxialiter subglabra, coma trichomatibus villosis secundum midnervium, prope apicem ornata, margine infera laevi et papyracea, fimbriae nullae; pseudopetiolus 2–4 mm longus; lamina (5–)15–23(–25) cm longa, (0.6–)1.3–2 cm lata, abaxialiter glabra dense papillosa et tessellata, apice acuminato. Synflorescentiae non visae. Caryopsis non visa.

Woody, thorny bamboo. Rhizomes pachymorph. **Culms** (15–)18–25 m tall, (3.5–)7–12 cm in diam., erect at base, arching from the middle to the apical portion, whitish-green when young, dark green at maturity; **internodes** 22–50(–70) cm long, cylindrical, hollow, some filled with water, the wall 1–1.5 cm thick, densely pubescent, with white hairs when young, glabrous and smooth when mature; **nodes** solitary, the nodal line horizontal, with a pubescent supranodal band 1.45–2.2 cm wide of dense, white, soft, appressed short hairs, and an infranodal band 1–2 cm wide of white, appressed hairs, the supranodal ridge pronounced; **bud** single, triangular. **Culm leaves** 29–57 cm long, 35–54 cm wide at the base, coriaceous, deciduous, triangular,

blade and sheath conspicuously distinguished by color and pubescence when young; **sheaths** 23–50 cm long, whitish-green and maculate with red when young then becoming cream-brownish to stramineous, abaxially sericeous becoming glabrous, covered when young by a single type of hairs, appressed, transparent or silky hairs up to 1 mm long, looking like wool, easily detached from the surfaces, adaxially glabrous and shiny, the margins smooth and papery; **inner ligules** 0.5–1 mm long, straight to slightly curved at the middle, extending completely from margin to margin, adaxially glabrous and shiny, abaxially canescent, the margin densely ciliate, the cilia up to 0.6 mm long, whitish or grey in color; **blades** (4–)9–15 cm long, 14–17 cm wide, 1/5 as long as the sheath, broadly triangular, erect, persistent, inflated at the central part, green to reddish-green, abaxially glabrescent, less pubescent than the sheath and different in color, adaxially densely hispid between the nerves, covered by transparent, non-appressed, stiff hairs, up to 2.5 mm long, stramineous or brownish when young becoming gray, glabrescent toward the margins, the margins papery, fimbriae to smooth, the apex mucronate, the mucro 1.2–1.5 mm long. **Branching** intravaginal, consisting of one main branch and 1 to 6 secondary branches, the branches manifestly armed, thorns (1–)3–4 per node, curved or recurved. **Foliage leaves** 5–8(–10) per complement; **sheaths** subglabrous, with a patch of hyaline, villous hairs along the midnerve near the apex, the summit glabrous, the overlapping margin conspicuously ciliate, the underlapping one ciliolate to smooth and papery; **inner ligules** 0.3–0.5 mm long, puberulous, the margin minutely ciliolate to smooth; **outer ligules** 0.2–0.3 mm long, glabrous and shiny, stramineous, the margin smooth; **pseudopetioles** 2–4 mm long, adaxially scabridulous, abaxially glabrous and pulvinate, the pulvinus yellowish, shiny; **blades** (5–)15–23(–25) cm long, (0.6–)1.3–2 cm wide, L:W = 8–13:1, 11–14-nerved, linear-lanceolate, adaxially usually glabrous, rarely bearing sparse, transparent, strigose hairs up to 1 mm long, with 3–5 raised scabrid submarginal nerves on one side, abaxially glabrous, densely papillose and tessellate, the midrib and primary nerves prominent and yellow at the middle and lower part, one margin scabrous, the other scabridulous, the apex acuminate with a mucro 1.5–2.5 mm long. **Synflorescences** not seen. **Fruit** not seen.

Etymology.—The specific epithet makes reference to the Amazon biogeographical district of the Chapare River, Cochabamba, Bolivia, where this species is found.

Distribution and habitat.—Known only from the department of Cochabamba, Carrasco, Chapare, below 900 m of elevation, with a total annual precipitation estimated to be 6000 mm and a median temperature of 25°C. It occurs along rivers and creeks, such as the Sajta and Ivirza, and is associated with *Hura crepitans* L., *Guadua sarcocarpa* Londoño & Peterson, *Mendoncia aspera* Nees, *Cecropia* sp., and *Costus* sp.

Common name.—Tacuara hembra or tacuara.

Uses.—*Guadua chaparensis* culms are used by local communities to make fences, walls, water containers, and for conducting water.

Affinities.—*Guadua chaparensis* most closely resembles *G. tagoara* (Nees) Kunth and *G. incana*. They share a culm that is whitish-green when young to dark green at maturity; cylindrical and elongated internodes 20 to 80 cm long with walls less than 15 mm thick; coriaceous culm leaves with inner ligules straight to slightly curved at the middle, abaxially with a canescent indument, looking like wool and easily detached, with the margins densely ciliate; a prominent supranodal ridge; foliage leaves in complements of 5 to 8(–10); foliage leaf sheaths bearing a patch of villous hairs along the midnerve near the apex; pulvinate pseudopetioles that are abaxially glabrous; and a prominent and yellow midnerve and primary nerves on the abaxial surfaces of the foliage leaf blades (Table 1).

Although they share several characters, *Guadua chaparensis* has a combination of vegetative features that distinguishes it from *G. incana* and *G. tagoara* even in the absence of inflorescences. The most evident ones are (a) the sericeous abaxial surface of the culm leaf sheaths, covered by one type of hair (vs. pubescent, covered by two or three different types of hair and forming a hispid surface); and (b) the absence of fimbriae at the summit of the foliage leaf sheath (vs. present) (Table 1). With respect to *G. weberbaueri* and *G. sarcocarpa*, *G. chaparensis* also shares several vegetative characters listed in Table 1.

Additional specimens examined. **BOLIVIA. Cochabamba:** Prov. Carrasco, localidad Israel, 270 m, 17° 14' 56" S, 64° 51' 84" W, 270 m, 5 May 2004, *Zurita & Baldelomar EZ176* (BOL, CUVC); al borde del camino, 270 m, 17° 12' 20" S, 64° 49' 36" W, 270 m, 4 May 2005,

Zurita & Soto EZ320 (BOL, COL); Israel, 270 m, 22 Nov 2005, *Zurita & Soto EZ324* (BOL, TULV); Proyecto Valle del Sacta, km 240 en la carretera Santa Cruz-Villa Tunari, 64° 46' W, 17° 0' S, 290 m, 12–14 Jul 1989 (-), *D. N. Smith, V. Garcia, M. Buddensiek, J. Leon & C. Negrete 13720* (MO).

Guadua weberbaueri Pilger, Feddes. Repert. Spec. Nov. Regni Veg. 1:152. 1905; *Bambusa weberbaueri* (Pilger) McClure, Smithsonian Contr. Bot. 9:68. 1973. TYPE: PERU. San Martín: Moyobamba, 800–900 m, "marona," *Weberbauer 4562* (HOLOTYPE: B, destroyed; LECTOTYPE, here designated: MOL #00007883; ISOLECTOTYPE: US #79101! fragment).

Etymology.—The specific epithet refers to the German botanist and expedition leader August Weberbauer (1871–1948), who devoted his life to studying the flora of Peru.

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